

1. A feed table apparatus for use in moving a workpiece to a machine tool, the apparatus comprising:

a conveyor for supporting the workpiece;

a shuttle vise movably disposed on the conveyor and having jaws thereon adapted for clamping the workpiece when a clamping force is applied thereto; and

a reaction system connected to the shuttle vise adapted for applying a reaction force in an opposite direction of the clamping force and thereby substantially counteracting the clamping force.

2. The apparatus of claim 1 further comprising a feed table frame, wherein the conveyor is attached to the feed table frame and supported along a length of the conveyor.

3. The apparatus of claim 2 further comprising a spacer disposed between the conveyor and the feed table frame, the spacer supporting the conveyor along substantially the entire length thereof.

4. The apparatus of claim 2 further comprising a plurality of spacers disposed between the conveyor and the feed table frame.

5. The apparatus of claim 1 wherein:
the shuttle vise comprises:
a first vertical column;
a second vertical column;
an upper guide rail interconnecting upper portions of the first and second vertical columns;
a first jaw;
a second jaw, at least one of the first and second jaws being movably disposed on the upper guide bar, the first and second jaws being adapted for clamping engagement with the workpiece; and
a clamping actuator for moving the one jaw into and out of clamping engagement with the workpiece and applying the clamping force thereto.
6. The apparatus of claim 5 wherein:
the clamping actuator is attached to one of the vertical columns; and
the reaction system comprises:
a lever arm pivotally attached to the upper guide rail adjacent to the one vertical column; and
a reaction actuator connected to the lever arm for applying the reaction force to the one vertical column.
7. The apparatus of claim 6 wherein the reaction actuator is connected to an end of the lever arm such that the other end of the lever arm engages the one vertical column and thereby applies the reaction force thereto.

8. The apparatus of claim 6 wherein the reaction actuator is attached to an end of the lever arm such that the reaction actuator engages the one vertical column and thereby applies the reaction force thereto.

9. The apparatus of claim 6 wherein:
the clamping actuator and the reaction actuator are hydraulic cylinders; and
the clamping actuator and the reaction actuator are connected to a single pressure source.

10. The apparatus of claim 9 further comprising regulators connected to the clamping actuator and the reaction actuator.

11. The apparatus of claim 5 wherein:
the reaction system comprises a clamping force bar disposed adjacent to the upper guide bar, wherein the clamping actuator is attached to the clamping force bar such that clamping forces are not transmitted to the vertical columns of the shuttle vise.

12. The apparatus of claim 11 further comprising a plurality of links pivotally attached to the clamping force bar and to the upper guide bar.

13. The apparatus of claim 11 further comprising a bushing mounted in the first vertical column wherein a portion of the clamping actuator is supported by the bushing.

14. The apparatus of claim 11 wherein the reaction system further comprises a reaction actuator to engage one of the vertical columns.

15. The apparatus of claim 5 wherein:
the conveyor has a guide rail extending from opposite sides thereof; and
lower ends of the vertical columns in the shuttle vise are supported by the guide rails and movable therealong.

16. The apparatus of claim 15 further comprising a plurality of rollers mounted on the lower ends of the vertical columns and engaging the horizontal rails and thereby giving rolling support on the horizontal rails.

17. The apparatus of claim 1 wherein lower ends of the first and second vertical columns are not interconnected.

18. A feed table apparatus for use in moving a workpiece to a machine tool, the apparatus comprising:

a conveyor for supporting the workpiece;

a shuttle vise movably disposed on the conveyor, the shuttle vise comprising:

a first vertical column;

a second vertical column;

an upper guide rail interconnecting upper portions of the first and second vertical columns;

a first jaw disposed on the upper guide bar;

a second jaw opposite the first jaw, at least one of the first and second jaws being movable; and

a clamping actuator attached to the first vertical column for moving the first jaw toward the second jaw and thereby providing clamping engagement of the first and second jaws with the workpiece and applying a clamping force thereto; and

a reaction system connected to the shuttle vise adapted for applying a reaction force in an opposite direction of the clamping force and thereby substantially counteracting the clamping force.

19. The apparatus of claim 18 further comprising a feed table frame, wherein the conveyor is attached to the feed table frame and supported along a length of the conveyor.

20. The apparatus of claim 19 further comprising a spacer disposed between the conveyor and the feed table frame, the spacer supporting the conveyor along substantially the entire length thereof.

21. The apparatus of claim 18 wherein:

the reaction system comprises:

a first lever arm pivotally attached to a first end of the upper guide rail adjacent to the first vertical column;

a second lever arm pivotally attached to a second end of the upper guide rail adjacent to the second vertical column;

a reaction actuator interconnecting upper ends of the first and second lever arms for applying force thereto such that lower ends of the first and second lever arms engage the first and second vertical columns, respectively, thereby applying the reaction force to the vertical columns.

22. The apparatus of claim 21 wherein:

the clamping actuator and the reaction actuator are hydraulic cylinders; and

the clamping actuator and the reaction actuator are connected to a single pressure source.

23. The apparatus of claim 22 further comprising regulators connected to the clamping actuator and the reaction actuator.

24. The apparatus of claim 18 wherein:

the reaction system comprises:

a first lever arm pivotally attached to a first end of the upper guide rail adjacent to the first vertical column;

a second lever arm pivotally attached to a second end of the upper guide rail adjacent to the second vertical column;

a reaction bar interconnecting upper ends of the first and second lever arms; and

a reaction actuator attached to lower ends of each of the first and second lever arms such that each of the reaction actuators engages one of the first and second vertical columns and thereby applies the reaction force thereto.

25. The apparatus of claim 18 wherein:

the conveyor has a guide rail extending from opposite sides thereof; and

lower ends of the vertical columns in the shuttle vise are supported by the guide rails and movable therealong.

26. The apparatus of claim 25 further comprising a plurality of rollers mounted on the lower ends of the vertical columns and engaging the horizontal rails and thereby giving rolling support on the horizontal rails.

27. The apparatus of claim 18 wherein lower ends of the first and second vertical columns are not interconnected.

28. A feed table apparatus for use in moving a workpiece to a machine tool, the apparatus comprising:

a conveyor for supporting the workpiece;

a shuttle vise movably disposed on the conveyor, the shuttle vise comprising:

a first vertical column;

a second vertical column;

an upper guide rail interconnecting upper portions of the first and second vertical columns;

a first jaw movably disposed on the upper guide bar; and

a second jaw opposite the first jaw; and

a reaction system connected to the shuttle vise and adapted for applying a reaction force in an opposite direction of the clamping force and thereby substantially counteracting the clamping force, the reaction system comprising a clamping force bar disposed adjacent to the upper guide bar; and

a clamping actuator for moving the first jaw toward the second jaw and thereby providing clamping engagement of the first and second jaws with the workpiece and applying a clamping force thereto, the clamping actuator being attached to the clamp force bar such that the clamping forces are not transmitted to the vertical columns of the shuttle vise.

29. The apparatus of claim 28 wherein the reaction system further comprises a plurality of links pivotally attached to the clamping force bar and to the upper guide bar.

30. The apparatus of claim 28 further comprising a bushing mounted on the first vertical column;

wherein, the clamping actuator has a rod portion extending through, and supported by, the bushing.

31. The apparatus of claim 28 further comprising a feed table frame, wherein the conveyor is attached to the feed table frame and supported along a length of the conveyor.

32. The apparatus of claim 31 further comprising a spacer disposed between the conveyor and the feed table frame, the spacer supporting the conveyor along substantially the entire length thereof.

33. The apparatus of claim 28 wherein:
the conveyor has a guide rail extending from opposite sides thereof; and
lower ends of the vertical columns in the shuttle vise are supported by the guide rails and movable therealong.

34. The apparatus of claim 33 further comprising a plurality of rollers mounted on the lower ends of the vertical columns and engaging the horizontal rails and thereby giving rolling support on the horizontal rails.

35. The apparatus of claim 28 wherein lower ends of the first and second vertical columns are not interconnected.

36. The apparatus of claim 28 wherein the reaction system further comprises a reaction actuator to engage one of the vertical columns.

37. The apparatus of claim 28 wherein the second jaw is stationary.